Attachment 1: Description of Emission Reduction Measure Form

Please fill out one form for each emission reduction measure. See instructions in Attachment 2.

Title: Active Management of California's Forest Service National Forestlands

Type of Measure (check all that apply):

- ☐ Direct Regulation
- ☐ Market-Based Compliance
- ☐ Monetary Incentive
- ☐ Non-Monetary Incentive
- ☒ Voluntary
- ☐ Alternative Compliance Mechanism
- ☐ Other Describe:

Responsible Agency: ARB

Sector:

- ☐ Transportation
- ☐ Electricity Generation
- ☐ Other Industrial
- ☐ Refineries
- ☐ Agriculture
- ☐ Cement
- ☒ Sequestration
- ☒ Other Describe: **Substitution and Biomass Offsets**

2020 Baseline Emissions Assumed (MMT CO2E): -16

Percent Reduction in 2020: 400

Cost-Effectiveness ($/metric ton CO2E) in 2020: 0

Description: 18 million tons of CO2e annually from sequestration on California' productive, unreserved national forestlands by increasing commercial thinning and fuels reduction accomplishments fivefold annually.

A direct result of active management on Forest Service productive, unreserved lands would be 50-60% reduction in forestland acres burned in wildfires (% based on Forest Service Research); equates to at least a direct reduction of 1 million tons of CO2e (Winrock International). We actually believe data will show that the range of carbon volatilized in forest wildfires in California is 35-75 tons/acre burned (Winrock data). We also know that over the past 10 years, average acres of forestlands burned in California is 212,000 acres (Forest Service, FIA, 2005). Therefore we believe actual CO2e emissions from Calif. forestland wildfires is at least 7 million tons/year and if reduced 50% would show a reduction of 3.5 million tons CO2e annually.

Solid wood products are a direct substitute for non-renewable steel or concrete products and thus provide a direct offset. Science (www.corrim.org) indicates non-renewables

require at least 250 percent more fossil fuel energy than an equivalent wood product. In a 100 year carbon life cycle, this "substitution" of wood for non-renewables amounts to 2 tons CO2e/acre of actively managed forest. If the Forest Service's 9.8 million acres of productive, unreserved lands were actively managed plus the 4 million acres of private industrial accounted for, wood "substitution" for non-renewables could provide a direct offset of 27.6 million tons of CO2e annually.

Using the wood waste generated from a fivefold increase in active fuels reduction on national forests in California would generate 6.5 million bone dry tons that could be used in biomass powerplants to generate electricity and provide 6.5 million tons of direct net reduction of ghg emissions from a fossil fuel-fired powerplant

Totaling all of the above -- Active management of the Forest Service productive forestlands that are not reserved, accounting for substitution of wood products for non-renewables, and accounting for biomass for power generation as a direct offset to fossil-fuel fired powerplants shows an potential opportunity of over 50 million tons CO2e annually that could apply to AB 32 emission reductions goals.

Emission Reduction Calculations and Assumptions:
Sequestration from actively managed productive, unreserved National Forest lands -- 9.8 million acres X 0.5 tons carbon/acre/year X 3.67 = 18 million tons CO2 e net sequestration including carbon storage in solid wood products.

9.8 million acres active management on national forests plus 4 million acres active management on private industrial = 13.8 million acres of active forest management in California (note does not account for the potential opportunity on the 4.7 million acres of productive private non-industrial forestlands in California.

Forest Service researchers suggest actively managed national forests would reduce the annual forestland acres burned by wildfire by 50-60%. Winrock estimates 2 million tons of CO2e in annual emissions in California from forestland wildfires. Hence at least a 1 million ton CO2e reduction opportunity. We believe this number is actually much greater. Winrock's own data indicates expected volatilization of carbon in wildfires of 35-75 tons of CO2e/acre burned. Average acres of forestland burned in California over the last 10 years is 212,000 acres so we think the potential CO2e reduction for reduced wildfire could be 3.5 million tons CO2e annually.

Dr. Bruce Lippke (www.corrim.org) has clearly shown that using solid wood as a building material substitute for non-renewable steel or concrete building materials provides a 60-80% reduction in fossil fuel energy requirements. This "substitution" offset provides 2 tons of CO2e/acre/year X 13.8 million acres active management = potential opportunity of 27. 8 million tons CO2e reduction.

Dr. Gregg Morris, Green Power Institute, has clearly demonstrated that for every 1 bone dry ton of wood waste used in a biomass powerplant to generate electricity provides at least a 1 ton net reduction in ghg emissions from a fossil fuel-fired powerplant.

If the Forest Service was performing 600,000 acres/year of commercial thinning and fuels reduction annually rather than there current 100,000 acres/year, there would be at least an additional 7 million bone dry tons of wood waste available for power generation. Hence, a 7 million ton CO2e reduction opportunity.

Adding up the potential opportunities from net sequestration, substitution of solid wood products for non-renewables, and biomass power generation offsets for fossil fuel-fired powerplants equals 50 million tons of CO2e annually that could be applied to AB 32 emission reduction goals.

Cost-Effectiveness Calculation and Assumptions:
Actively managed forests are a positive net revenue generator. Therefore, the potential 50 million ton CO2e emission reduction measure offered here is "free" to California.

Implementation Barriers and Ways to Overcome Them:
Active management of the Forest Service productive, unreserved forest lands -- Federal Legislation would be required to declare an emergency for federal forestlands at risk to catastrophic wildfire creating a new category of exclusion from NEPA. Currently National Forests in California have 7.5 million acres of productive forestland at risk to catastrophic wildfire.

It would take the Governor to engage the Congress and Executive Branches of Federal Government to provide needed Federal Legislation to free-up the Forest Service to return to active forest management creating healthy forests that are resistant to insects, disease, and wildfire.

There are biomass for power generation barriers that have been addressed and outlined by the California Biomass Collaborative in their Dec. 2006 "A Preliminary Roadmap for the Development of Biomass in California", pp. xii-xx.

The next most important biomass economic issue to overcome is to return to the PURPA SO4 type power-purchase contracts to provide a reasonable price for investors to engage.

Last, the State (CEC and PUC) simply has to recognize the 11 cent/kilowatt "uncompensated" social and environmental benefit of using woody biomass for power generation. If the public goods charge (PGC) were increased from its current 0.9 cents/kilowatt to 2-3 cents/kilowatt, there would a substantial increase in the consumption of existing but currently uneconomic woody biomass in the State. The uncompensated benefits have been well documented by the Western Governors Association (January 2006, Biomass Taskforce Report) and by two publications by Dr. Gregg Morris, Green Power Institute.

Potential Impact on Criteria and Toxic Pollutants: There would be diesel engine emissions increases over current levels for forest operations, manufacturing of solid

wood products, and biomass for power generation due to the fivefold increase in annual active forest management on productive National Forests lands.

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Attachment 1: Description of Emission Reduction Measure Form

Please fill out one form for each emission reduction measure. See instructions in Attachment 2.

Title: Use of Chicago Climate Exchange Forestry Protocols

Type of Measure (check all that apply):

- ☐ Direct Regulation
- ☐ Market-Based Compliance
- ☐ Monetary Incentive
- ☐ Non-Monetary Incentive
- ☒ Voluntary
- ☐ Alternative Compliance Mechanism
- ☐ Other Describe:

Responsible Agency: ARB

Sector:

- ☐ Transportation
- ☐ Electricity Generation
- ☐ Other Industrial
- ☐ Refineries
- ☐ Agriculture
- ☐ Cement
- ☒ Sequestration
- ☐ Other Describe:

2020 Baseline Emissions Assumed (MMT CO2E): 11

Percent Reduction in 2020: 10%

Cost-Effectiveness ($/metric ton CO2E) in 2020: 0

Description: Emissions reduction would be accomplished through additional net sequestration of carbon dioxide through working forests and associated carbon storage in long-lived wood products. By using the Chicago Climate Exchange (CCX) forestry protocols, all California forest landowners (both public and private) could easily register and use the existing trading platform.

Since working forests are a net revenue generator, there is no cost to the additional emissions reduction that would be applicable to AB32 implementation. Since CO2e is currently trading at $3-5/ton on the CCX, and working forests sequester at least double the amount of carbon annually as an unmanaged forest, a forest landowner, that currently does not actively manage their forest, could realize about 0.5-1.0 ton of carbon/acre/year to pool and trade. One ton of carbon is 3.67 tons of CO2e at $5/ton = $18/acre/year. This may be sufficient incentive for some currently unmanaged productive California forestlands to be switched to active management.

Emission Reduction Calculations and Assumptions: Determining an actual number of acres that would be converted to active management is not possible. An estimated amount of 10% would be about 2 million acres of California's 19.6 million acres of productive forestlands that are not reserved.

Cost-Effectiveness Calculation and Assumptions: Working forests are a net revenue generator and thus the additional net sequestration and carbon storage in long-lived wood products is "free" to AB 32 emissions reduction.

Implementation Barriers and Ways to Overcome Them: Awaiting Chicago Climate Exchange to publish their forestry protocol.

Potential Impact on Criteria and Toxic Pollutants: There would be a small increase in NOx and particulate matter associated with the harvest of trees and manufacture of wood products.

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Attachment 1: Description of Emission Reduction Measure Form

Please fill out one form for each emission reduction measure. See instructions in Attachment 2.

Title: Planktos Inc.: GHG Offsets via Forest and Ocean Carbon Capture & Sequestration (CCS)

Type of Measure (check all that apply):

- ☐ Direct Regulation
- ☒ Market-Based Compliance
- ☐ Monetary Incentive
- ☒ Non-Monetary Incentive
- ☒ Voluntary
- ☐ Alternative Compliance Mechanism
- ☐ Other Describe: **This measure enables all sources, regulated or voluntary, to offset and/or remediate GHG emissions and atmospheric CO2. This measure depends on monetary incentives to generate marketable assets (carbon credits). This measure delivers non-market (non-monetary) value in the form of collateral environmental benefits effecting water quality, water supply and biodiversity.**

Responsible Agency: ARB, EPA, CAR

Sector:

- ☐ Transportation
- ☐ Electricity Generation
- ☐ Other Industrial
- ☐ Refineries
- ☐ Agriculture
- ☐ Cement
- ☒ Sequestration
- ☐ Other Describe:

2020 Baseline Emissions Assumed (MMT CO2E): 0.005 MT total to 2020 from office and transportation related sources.

Percent Reduction in 2020: Offsets produced between 2007-2020 will be ~150,000,000 tons, compared against emissions of ~5000 tons associated with business operations. Planktos is a net provider of GHG offsets. Thus, 30000% 'reduction' against 2020 projected emissions.

Cost-Effectiveness ($/metric ton CO2E) in 2020: Planktos ocean carbon costs = $1.60 / ton CO2e. Spreadsheet available on request.

Description: Planktos Inc. is a carbon capture & sequestration compamy, mitigating greenhouse gas emissions by restoring forests on land and plankton communities in the open ocean.

Planktos is engaged in restoring plankton productivity to portions of the open ocean. By restoring iron nutrients that have been declining in volume for the past 30 years,

phytoplankton communities will be returned in 10,000 hectare 'patches' of the pelagic ocean known to be iron poor.

Plankton are extremely efficient producers, and when relieved of nutrient stress will establish short-lived (4-6 months duration) pelagic ocean communities supporting krill, pelagic fish species, sea mammals and sea birds. In so doing, at least 20% of plankton biomass carbon will be exported to long term storage in the deep ocean (below 500 meters). Plankton restoration technology promises to provide the most cost effective, highest volume, quickest and most environmentally beneficial GHG mitigation of any technology currently proposed.

Planktos is seeking opportunities to demonstrate the benefits of this ocean restoration technology to Californians, in concert with local scientists and California agency representatives. Local demonstrations can be undertaken within the 200-mile California exclusive economic zone (EEZ), outside the California Current, and in open pelagic waters. Although Planktos plans to demonstrate the value of iron restoration in 10,000 sq. km. ocean 'patches', any size demonstration may be arranged. Benefits from a demonstration within California waters will include contributions to local anchovy populatioins, hence local sea mammal / sea bird propagation and survival. Measurable benefits to commercial fisheries can also be anticipated.

Emission Reduction Calculations and Assumptions: For Planktos ocean projects: 150 MT (minimum) CO2 sequestered as ocean biomass, 2007-2020.

Cost-Effectiveness Calculation and Assumptions: For Planktos: $233 M capital, O&M against 146 MT sequestered = $1.60 per ton cost

Spreadsheet available on request.

Implementation Barriers and Ways to Overcome Them: Barriers to application of ocean CCS are largely institutional in nature. Agencies have indicated that verification of biological offsets invites a great deal of uncertainty. Agencies have indicated that permanence of biological offsets cannot be assured.

However, methods for restoring ocean plankton productivity have been affirmed as a result of 10 international research endeavors and expenditures of over $100 million in public funds. Methods for monitoring, measuring and calculating long term sequestration of carbon in forest biomass/soils, and in the deep ocean below 500 meters are also well known.

If agencies remain concerned about issues of verifiability and permanence, and yet if biological offsets represent cost effective, environmentally beneficial additions to the "GHG management toolkit," then it remains for agencies to develop fair and reasonable performance standards dedicated to 'real, additional, verifiable, permament, enforceable and transparent' GHG offsets. Planktos and other offset providers remain committed to

these same goals, as reflected in the methodologies overseen by the CA Climate Action Registry. In this vein, Planktos has retained the services of Tetra Tech/EMI and DNV, both companies certifed by the California Climate Action Registry, to help develop verification strategies related to ocean biomass carbon capture & sequestration.

By continuing to develop reasonable performance criteria, and by continuing to insist on 'best available technology' for biological offsets, California agencies can optimize the role of biological offsets in helping the state achieve the ambitious goals of AB 32.

Potential Impact on Criteria and Toxic Pollutants: There will be no criteria or toxic pollutants created by either new forest or ocean restoration CCS.

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ENVIRONMENTAL DEFENSE
finding the ways that work

Attachment 1: Description of Emissions Reduction Measure Form

Please fill out one form for each emission reduction measure. See instructions on attachment 2.

Title: Manage forestry and agriculture sectors to facilitate long term GHG sequestration while creating opportunities to enhance wildlife habitat, improve water quality, and expand recreational opportunities.

Type of Measure (check all that apply):

☑ Direct regulation
☑ Monetary Incentive
☐ Voluntary
☑ Other Describe: Collaboration with Federal Land Agencies
☑ Market-based compliance: Offsets
☑ Non-monetary incentive
☐ Alternative Compliance Mechanism

Responsible Agency: California Air Resources Board

Sector:

☐ Transportation
☐ Other Industrial
☑ Agriculture (and Forestry)
☑ Sequestration (Terrestrial/ Forestry)
☐ Electricity Generation
☐ Refineries
☐ Cement
☐ Other Describe:

2020 Baseline Emissions assumed (MMT CO2 eq): Unknown.

Percent reduction in 2020: See Below.

Cost effectiveness ($/metric ton CO2E) in 2020: See Below.

Description:

Forests

Forests can and should play an important role in meeting California's 2020 and 2050 emission reduction targets. California forests have the potential to sequester significant amount of CO2 mitigating climate change and providing a suite of additional environmental benefits associated with enhanced wildlife habitat, improved water quality, and expanded recreational opportunities. That said, if improperly managed, forests can serve as a source of emissions due

to catastrophic wildfire, decline in forest health, conversion, and unsustainable levels of harvest. California should promote forest restoration and improved forest management to sequester carbon, increase resilience to fire and other natural disturbance, and enhance overall ecological integrity of forest ecosystems. Our policy recommendations include:

Emission reduction target and inventory: The state should set an emission reduction target for the forest sector. The target should be based on a detailed inventory and ecological assessment of forests by subregion and forest type. Some forests are amenable to additional carbon sequestration and others are not (i.e., overstocked forests subject to catastrophic fire risk and insect/disease damage). The inventory and assessment would provide a scientific basis for setting a reasonable net emission reduction target for the forest sector.

Forestry offsets: Environmental Defense supports creating opportunities for generating offsets for carbon sequestration in the forest sector. An offset program should be built upon strong measurement and verification protocols and on a strong scientific understanding of forest dynamics. The CCAR Forestry Protocols are a good start but we believe targeted improvements must be made in order for them to function effectively under a cap and trade program. As a guideline, we recommend that CARB look closely at the recently published manual for GHG offset project entitle *Harnessing Farms and Forests in the Low Carbon Economy* (Duke University Press, 2007). Initially, offset opportunities in the forestry sector should be limited to reforestation, urban forest planting, and avoided conversion/forest conservation projects. Strong measurement and accounting protocols have been developed for projects of these types and widespread certainty exists in the scientific community about real, verifiable climate benefits from projects in these sectors. Projects on managed timberland also hold great promise (e.g., extending rotation length, increasing retention) although they are more difficult to quantify and issues of baseline, additionality and leakage must be examined quite closely order to ensure true net GHG emission reduction. The *Harnessing Farms and Forests* publication includes detailed protocols for addressing each of these issues in a robust manner. Projects certified under the existing CCAR forest protocols as well as those supported through PG&E's Climate Smart offset program offer excellent opportunities to test and refine measurement and verification protocols.

Additional incentives: Environmental Defense supports implementation of a suite of incentive-based programs to encourage private landowners to engage in forest management that sequesters carbon and enhances forests ecological integrity. Specifically, we recommend that programs such as the California Forest Improvement Program (CalFire) that provide technical and financial assistance to private landowners be greatly enhanced and funded at substantially higher levels. Incentive programs at the state level should be coupled with federal incentive programs (e.g., Farm Bill conservation programs) to the greatest extent possible.

Federal forestland: CARB, in collaboration with the Resources Agency and CalFire, must work closely US Forest Service, Bureau of Land Management, and National Park Service to improve the ecological integrity of forest land in federal ownership in California. Nearly half of California's 30 million acres of forestland is in federal ownership. In particular, it is essential

that federal forests, particularly in the Sierra Nevada, be managed to increase their resilience to wildfire in order to reduce the frequency of catastrophic events.

Agriculture

As with forests, agricultural lands in California lands offer strong potential for both reducing GHG emissions and sequestering CO2 in vegetation and soils. For many cropping systems in California, additional research is necessary to determine the precise potential and the precise management practices that will capitalize on this potential. As information emerges from ongoing and new research, CARB should be prepared to take advantage of emerging opportunities for farmers and ranchers to participate in meeting California's emission reduction targets. Our policy recommendations include:

Agricultural offsets: Carbon sequestration in soils in the agricultural sector should be considered for inclusion as an offset opportunity in a cap and trade program. As with the forestry sector, an agricultural offset program should be built upon strong measurement and verification protocols and on a strong scientific understanding of dynamics in agricultural systems. As a guideline, we recommend that CARB look closely at the recently published manual for GHG offset project entitle *Harnessing Farms and Forests in the Low Carbon Economy* (Duke University Press, 2007).

Farm and ranchland protection: The state should greatly strengthen efforts to protect farm and ranchland from unplanned development including increased funding for agricultural conservation easements and strengthening and expanding the Williamson Act. In addition, Environmental Defense advocates a wide range of improved land use planning and smart growth policies which are articulated in our recommendations on land use.

***Farm engines*:** Farm vehicles and stationary engines represent a significant source of GHG emissions. Regulatory and incentive-based measures to reduce emissions and enhance the efficiency of these engines will have a significant climate benefit. Quantifying that benefit will require more detailed reporting about engine type and usage than currently available. CARB is already planning a rule to reduce emissions of criteria pollutants associated with in-use on-farm vehicles and should incorporate reductions in GHGs into this rule. Toward this end, CARB should consider ways to encourage increased fuel efficiency and use of alternative/low carbon fuels in farm equipment. Finally, CARB should facilitate and expand existing efforts to convert stationary diesel engines (e.g. irrigation pumps) to electric pumps.

Emission reduction calculations and assumptions:

The impact of any particular measure will depend upon the intensity at which it is implemented, the region of the state, and whether complementary measures are enacted. Until

these measures are better defined, we are unable to give emissions reductions estimates. We will work with CARB to develop these estimates.

Cost effectiveness calculation and assumptions:

The cost-effectiveness of any particular measure will depend upon the intensity at which it is implemented, the region of the state, and whether complementary measures are enacted. Until these measures are better defined, we are unable to give emissions reductions estimates. We will work with CARB to develop these estimates.

Implementation barriers and ways to overcome them:

None to be discussed at this time.

Potential impacts on criteria pollutants

None to be discussed at this time.

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Attachment 1: Description of Emissions Reduction Measure Form

Title: *Forest sector public goods charge and incentive-based regulatory framework*

Type of Measure (check all that apply):

☐ Direct regulation	☐ Market-based compliance:
☑ Monetary Incentive	☐ Non-monetary incentive
☑ Voluntary	☐ Alternative Compliance Mechanism
☐ Other Describe:	

Responsible agency:

The Air Resources Board (ARB) should partner closely with California Department of Fire and Forestry, the California Integrated Waste Management Board, and other state agencies. However, ARB would have primary responsibility for design, implementation and administration of the public goods charge (PGC) and emissions reductions programs. The Legislature will need to be consulted and, depending on resolution of legal questions, may need to affirmatively act to establish the PGC.

Sector:

☐ Transportation	☐ Electricity Generation
☐ Other Industrial	☐ Refineries
☐ Agriculture	☐ Cement
☑ Sequestration	☐ Other Describe:

2020 Baseline Emissions Assumed (MMT CO2E):

According to the Aug. 7 ARB staff draft inventory, net emissions from LULUCF have been increasing from -5.6 MMTCO2 in 1990 (i.e. net sequestration) to -2.1 MMTCO2 in 2004. Assuming that both removals (i.e. sinks) and emissions continue to grow at the average annual rate from 1990 to 2004 (0.06% and 1.82%, respectively), the LULUCF sector will produce net emissions of 3.1 MMTCO2 in 2020, an increase of 8.8 MMTCO2 relative to 1990 net emissions.

Percent Reduction in 2020:

With estimated annual emission reductions of 13.9 MMTCO2 in 2020, the policies proposed herein will result in net emissions of -10.8 MMTCO2 (i.e. net sequestration) in 2020 from the LULUCF sector. Projected net sectoral emissions in 2020 will be reduced by 5.2 MMTCO2 below the estimated 1990 emissions level.

Cost-Effectiveness ($/metric ton CO2E) in 2020:

The estimated average cost of emissions reductions from the full set of proposed policies is $33/metric tonne CO_2.[1]

[1] Excluding the costs of the R&D and administrative programs, the average cost of emissions reductions is $28/metric tonne CO_2.

Description:

This proposal is for a forest sector public goods charge (PGC) and an incentive-based regulatory framework to reduce net forest sector greenhouse gas emissions. The proposed incentive-based framework for the forest sector parallels the regulatory approach adopted for the electricity sector in which, for over 25 years, a fraction of the revenues from electricity consumption has been directed to investments that reduce the sector's carbon footprint.

Revenues from the forest sector PGC would be used to fund incentives to reduce emissions and increase sequestration on private forest lands, to improve wood product use efficiency, and to increase recycling of wood products. The PGC would also be used to support R&D into new technologies and management approaches to reducing forest sector emissions.

The proposed incentive-based regulatory framework has a number of components including establishment of a forest sector PGC, elaboration of a consumption-oriented accounting system, and a set of land-based and product-based programs to reduce emissions and increase sequestration. The following text provides greater detail on each of these components.

1. Consumption-oriented accounting framework:

In order to accurately determine net GHG emissions, ARB will need to adopt a consumption-oriented accounting framework for the LULUCF sector. This accounting framework will track emissions associated with wood product consumption, from growth through use to disposal. The LULUCF budget in the August 7 draft inventory is based on a consumption-oriented framework and provides an effective starting point.

It is essential, however, that state-specific estimates of harvested wood product (HWP) flows be developed including, in particular, cross-border imports and exports. Some information is already collected on forest product consumption, but this proposal will require a substantial expansion of this effort. ARB will need to develop reporting requirements and a tracking system that is not unduly burdensome on affected parties but that can provide the information that is needed to estimate total consumption with acceptable accuracy.

State-specific estimates will provide ARB a much more accurate estimate of actual emissions from the LULUCF sector, since California's land use and consumption profile is likely to be quite different than for the U.S. as a whole. Moreover, without state-specific data on HWP flows that is tracked over time, it will be impossible to evaluate progress towards the State's emissions goals for this sector.

Implementation of forest sector emissions reductions measures, such as those proposed below, will also require development of a comprehensive set of accounting and verification protocols. The California Climate Action Registry (CCAR) forest protocols should be considered as the starting point for the forest sector accounting system. Improvements should be made to the existing forest protocols and additional protocols should be developed for urban forestry and product-based measures such as increased recycling of HWP.

The development of an improved accounting framework and measurement protocols will not, by itself, result in emissions reductions. However, these steps are essential to support the overall portfolio of forest sector programs.

2. Forest sector public goods charge:

The proposed forest sector PGC's primary purpose is to create a stable revenue stream to support investments in projects that reduce emissions and increase sequestration in the forest

sector. The PGC will also help improve market efficiency by internalizing the cost of carbon emissions from the consumption of wood products. This will send a price signal to consumers regarding the climate impact of their consumption and create a level playing field as the cost of carbon is internalized in other sectors that produce products that compete with wood products for market share (i.e. steel and cement).

The forest sector PGC should have the following characteristics: 1.) it should be linked to the emissions profile of the product, taking into account both the permanence of the end use and the fraction of recycled material used, e.g. a higher fee would be levied on virgin paper than recycled; 2.) it should be relatively easy to administer and should avoid creating market distortions among products; and 3.) the fee should be relatively stable and reflective of the long-term average cost of carbon savings to the State. A well-designed and stable fee structure is essential for effective program implementation. The LULUCF sector is dominated by relatively slow biological processes and long-term management decisions. A stable program structure and funding base is necessary to allow landowners and forest product users to make what will often be very long-term management decisions with confidence.

As we discuss below, we believe the state could achieve approximately 13.9 MMTCO2 of reductions in 2020 at an average cost of about $33 per metric ton CO_2, including the costs of program administration and RD&D; therefore, funding on the order of $450 to 500 million per year will be required. To achieve that, we propose that a PGC of $25/tonne CO_2 be imposed on consumption of virgin paper products. We propose that the fee on solidwood products be set at $2.5/tonne CO_2 to reflect the much longer average product lifetimes and lower decomposition rate of wood relative to paper[2]. This translates to a fee of approximately $0.04/kg of paper and $0.0025/board foot of wood. Recycled products made from 100% post-consumer waste should be exempt from the fee. If imposed at this level, the PGC will produce revenue of approximately $450-500 million/year, based on estimated statewide consumption of wood products equal to 26-37 million tons of C02E per year[3].

The PGC should be used to provide incentives for a portfolio of measures, described below, that can significantly reduce the total emissions from forest product production and consumption in California.

3. Land-based programs:

Incentives, funded by the PGC, should be provided for 1.) forest conservation, afforestation/reforestation, and conservation forest management projects on private lands, 2.) urban forestry, and 3.) product-based projects that reduce CO_2 emissions. Protocols to measure and verify the savings from projects that receive the incentives should be developed building on the CCAR protocols, as we discussed above.

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[2] The average lifetime of solidwood products is approximately 3x longer than paper products. (K. Skog, pers. communication) The maximum fraction of carbon that decomposes is also much higher for paper than wood. (see: Micales, J.A. and K. Skog "The Decomposition of Forest Products in Landfills," USDA, Madison, WI 1997)

[3] Use of a population-weighted share of national consumption results in an estimate of statewide consumption of 37.4 MMTCO2E. (K. Skog, pers. communication). The 2003 Forest and Range Assessment estimated total statewide consumption of approximately 7 billion board feet of solidwood and 13 million tons paper, which is equivalent to 26.4 MMTCO2E. ("The Changing California: Forest and Range 2003 Assessment," CDF, Oct. 2003, chap. 6) The primary difference between the two estimates is in the volume of wood consumption.

A. Afforestation/reforestation – Establishment of trees on sites that are not currently forested can reduce net emissions as growing trees sequester carbon.

B. Forest conservation – Conversion of forest land to development, such as housing or commercial buildings, results in release of much or all of the carbon stored in the trees. Preventing conversion of forests by redirecting development onto already-cleared land can avoid the emissions that would otherwise have occurred. Forest conservation can also provide significant co-benefits by maintaining existing forest ecosystems and, in the case of infill development, avoiding the higher emissions associated with sprawl.

C. Conservation forest management – Some forest management practices can result in increased levels of sequestration in working forests. We recommend investment in wider stream buffers and no-harvest set aside areas on private lands which are viable and well-substantiated, relatively low cost, management measures that can result in substantial increases in the amount of carbon sequestered in managed forests.

D. Urban forestry – In addition to sequestering carbon, urban forests provide a range of co-benefits including shade and improved aesthetic values. An effective urban forestry program will need to carefully account for the net climate impact and leverage support from entities – such as homeowners and municipalities -- that benefit from the non-climate impacts.

4. Product-based programs:

The demand for forest products is a principal determinant of LULUCF emissions. Demand-side programs, such as increased recycling of forest products and improved wood-use efficiency can help to reduce net LULUCF sector emissions and should be an integral part of the regulatory framework. Funds collected by the PGC should be used support these programs as well.

5. Wood product research and development (R&D):

A key component of our proposed forest sector PGC program is support for climate-related forest sector research and development (R&D). As with the PIER program which is supported through the electricity and natural gas PGC,[4] investment in public goods R&D for the forest sector can provide enormous dividends through development of new technologies and management approaches. The focus of the forest sector R&D program should be on the following activities: 1. wood product use efficiency and recycling; 2. land management and biological sequestration; 3. forest sector accounting, measurement & verification tools and methods (including remote sensing); and 4. adaptation of forest ecosystems to climate change.

Emission Reduction Calculations and Assumptions:

The public goods charge would provide incentives for projects that deliver a total of 13.9 MMTCO2E in estimated emission reductions in 2020 from the following programs:

A. Afforestation/reforestation – The Updated Macroeconomic Analysis from the Climate Action Team estimates annual emissions reductions of 1.98 MMTC02E based on cumulative planting of 430,000 acres by 2020. However, CDF estimates that 7.1 million acres are available for

[4] The PIER program is supported by the legislatively-mandated public goods charge on electricity and natural gas and is managed by the California Energy Commission.

afforestation statewide.[5] We propose a four-fold increase in afforestation for a total emissions reduction of 7.9 MMTCO2E in 2020 from 1.72 million acres representing approximately 24% of available lands.

B. Forest conservation – The Updated Macroeconomic Analysis estimates annualized emissions reductions of 0.4 MMTC02E based on avoided conversion of 21,658 acres forestland and 6,817 acres woodland from 2000 to 2020. However, the 2003 Forest and Rangeland Assessment Program (FRAP) projected total conversion of 312,000 acres of forestland and 258,000 acres of woodland from 2000-2020[6]. We propose a four-fold increase in the forest conservation program, resulting in an estimated emissions reduction of 1.6 MMTCO2E in 2020.

C. Conservation forest management – Based on the Updated Macroeconomic Analysis, we propose that expansion of riparian buffer strips could provide 0.26 MMTCO2E in emissions reductions in 2020. We also propose that no harvest set asides in high ecosystem value forests could produce equivalent additional emissions reductions for a total of 0.52 MMTCO2E.

D. Urban forestry – Based on the Updated Macroeconomic Analysis from the Climate Action Team, we propose that urban forestry programs can produce 0.9 MMTCO2E in emissions reductions in 2020.

E. Product-based programs – We have not conducted any analysis of the potential emissions reductions from product-based programs and instead refer to the estimated impact of the "zero waste – high recycling program" from the Revised Macroeconomic Analysis which estimates emissions reductions of 3 MMTCO2E.

Cost-Effectiveness Calculation and Assumptions:
The cost of emissions reduction will vary substantially among the recommended programs and among particular projects within each program. However, we estimate that the average cost of emissions reductions from the full set of proposed programs is approximately $33/ton of CO2E[7] and that the total annual cost of the proposed portfolio of programs is $456 million based on the following assumptions:

A. Afforestation/reforestation – The Updated Macroeconomic Analysis estimates emissions reductions from afforestation will cost an average of $10.61/tonne CO2E. The need to expand the program to include less productive and less accessible lands will tend to raise costs, but returns to scale should tend to compensate by lowering average costs. Overall, we estimate that the average cost of our proposed program will be 25% higher than the program in the Updated Macroeconomic Analysis, with an annual program cost of $105 million and an average cost of emissions reductions of approximately $13/tonne CO2E.

B. Forest conservation – The Updated Macroeconomic Analysis estimates that emissions reductions from forest conservation will cost an average of $37.50/tonne CO2E. The

[5] "Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 Climate Action Team Report: Attachment B," Sept. 4, 2007
[6] Updated Macroeconomic Analysis: Att. B, p. 182
[7] The average cost-effectiveness of emissions reductions is calculated as the total annual cost divided by the annual savings in 2020.

significantly expanded scope of our proposed program will result in a higher average cost. Overall, we estimate that the average cost of our proposed program will be 25% higher, with an annual program cost of $75 million and an average cost of emissions reductions of approximately $47/tonne CO2E.

C. Conservation forest management – Following the Updated Macroeconomic Analysis, we estimate that the average cost of carbon sequestration from expanded riparian buffers would be approximately $19.67/tonne CO2E. We estimate that the expansion of the program to support no harvest set asides in high ecosystem value forests would double the size of the program at the same average cost of emissions. The total annual program cost is estimated to be $6.6 million.

D. Urban forestry – Based on the Updated Macroeconomic Analysis from the Climate Action Team, we estimate that an urban forestry program with a net cost of $132 million will result in an average cost of emissions reductions in 2020 of $150/tonne CO2E.

E. Product-based programs – We have not conducted any analysis of the cost of product-based programs and instead refer to the estimated cost of the "zero waste – high recycling program" from the Revised Macroeconomic Analysis which estimates a total annual cost of $69 million and an average cost of emissions reductions of $23/tonne CO2E.

F. R&D and administration – We propose allocating approximately 10% of the total revenue from the PGC to forest sector R&D or $46 million per year. We also estimate that program administration including program evaluation will cost approximately 5% of total PGC revenue or $23 million per year. There are no emissions reductions directly attributable to this investment. However, there are significant indirect benefits from targeted R&D including more effective programs, increased economic potential, and more accurate accounting of program impacts.

Implementation Barriers and Ways to Overcome Them:

Implementation barriers can be minimized by partnering with CDF, CIWMB, municipalities, CCAR and other stakeholders on the development of programs and new protocols and reporting requirements.

Potential Impact on Criteria and Toxic Pollutants:

The potential impact on criteria and toxic pollutants is likely to be relatively small. Urban forestry will reduce criteria and toxic pollutants through reduced urban temperatures (which lowers the rate of ozone formation) and adsorption into leaves. Afforestation/reforestation may result in the significant use of agricultural chemicals and local environmental impacts (e.g. erosion) during site preparation.

More generally, land-based forest sector GHG emissions reduction programs must acknowledge the significant potential ecological consequences associated with changes to forest management. Otherwise, AB32 implementation risks exchanging one set of environmental harms for another, and could well initiate an ultimately unsustainable set of land use practices. To avoid these pitfalls, the State's forest sector climate strategy must not reduce existing protections but should instead be designed to maintain and expand benefits to the forest ecosystems whose continued vitality we must be able to rely upon. The adoption of minimum performance requirements for all eligible forest sector projects will ensure that ecological and social standards are maintained and that negative impacts are avoided.

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